

East-coast heavy precipitation event of 29 Sep – 01 Oct 2010: results from GFS/EnKF ensembles

Tom Galarneau¹, Tom Hamill²,
and Jeff Whitaker²

¹CIRES and ²NOAA/ESRL

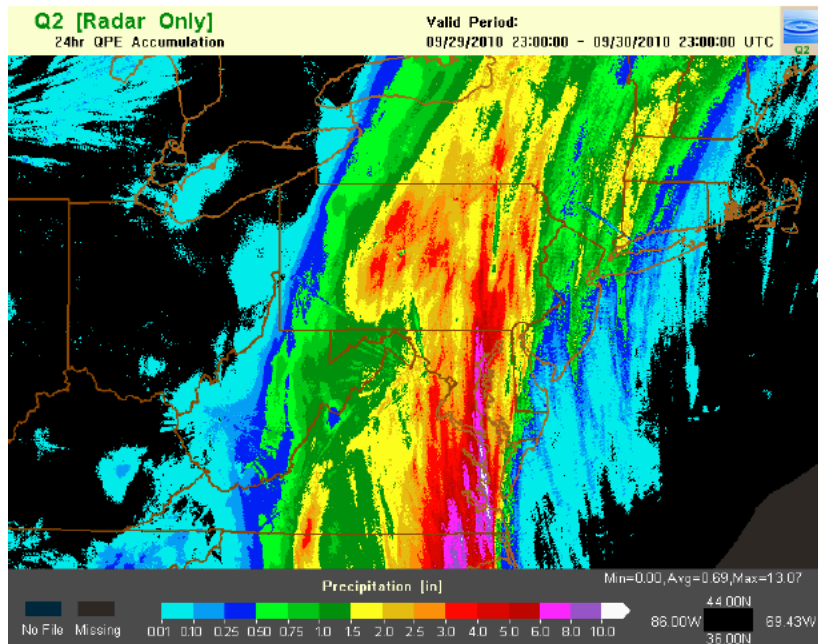
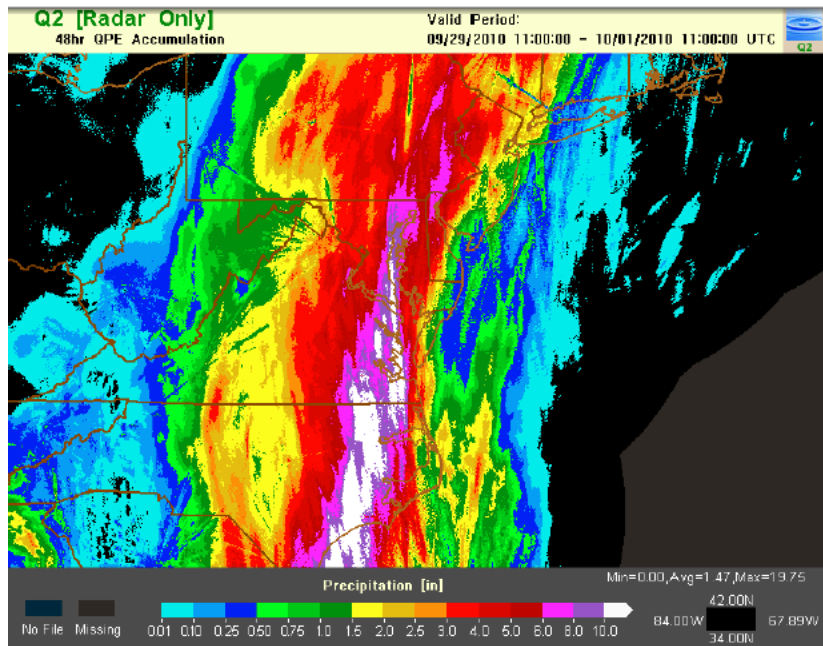


Figure 1. [Q2 precipitation](#) analysis over the Mid-Atlantic region. Upper panel is a 2-day total ending at 1100 UTC 1 October 2010 and the lower panels of the last 24 hours ending 2300 UTC 30 September 2010.

Preliminary
precipitation analysis,
c/o Rich Grumm,
NWS/WFO,
State College PA

massive and widespread East-coast
rain event, linked in part to moisture
advected ahead of remnants of
tropical storm Nicole.

EnKF configuration

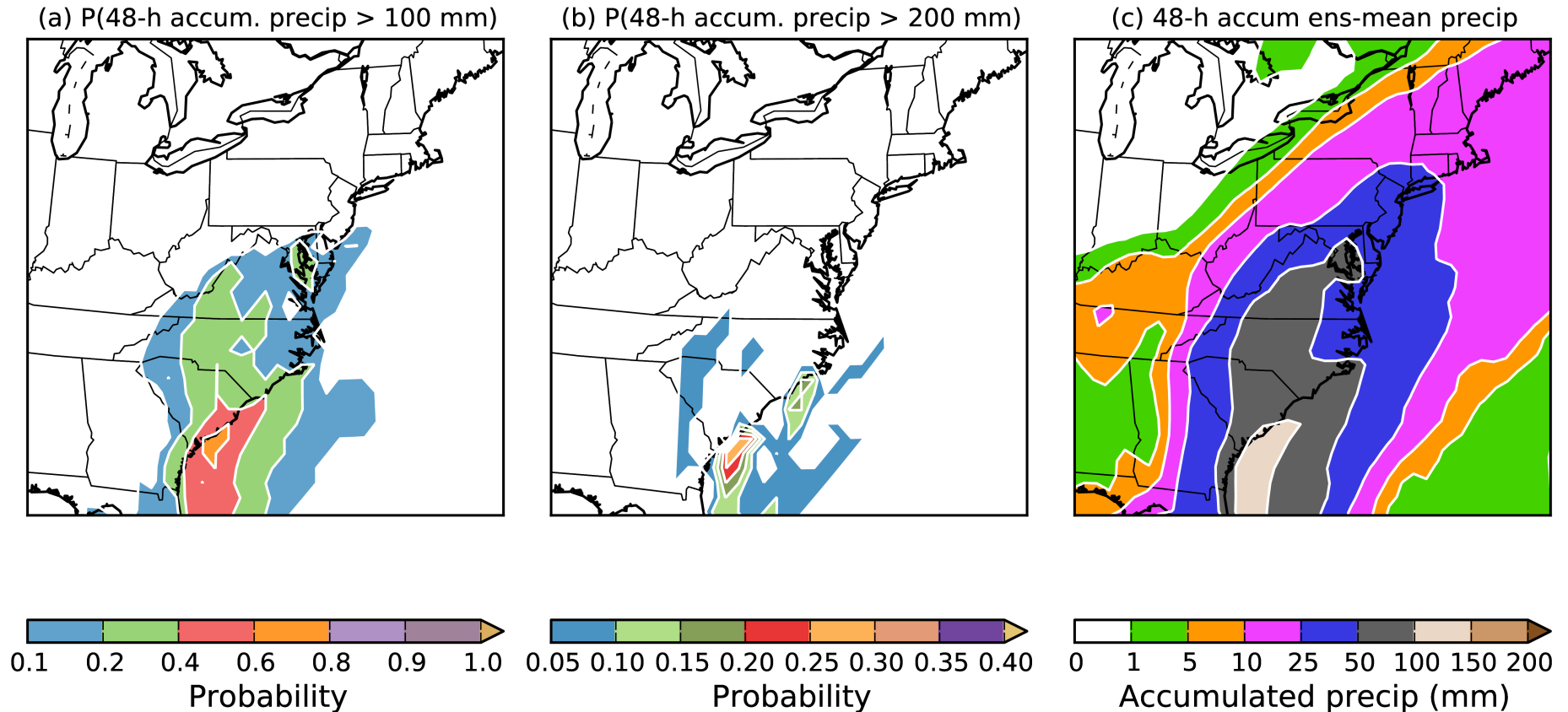
- Data assimilation this summer uses GFS model, at T254L64, 80 members; assimilated the full observational data stream + TCVitals MSLP observation. For more details on hurricane forecast skill, see <http://tinyurl.com/2ca3a8k>
- For 20 members of 80, we make 5-day forecast.
- Also: forecasts from ensemble mean at T254 and T574 resolution. For comparison, also have T574 forecasts initialized from GSI.

Preliminary conclusions about EnKF performance

- EnKF-based ensembles provided evidence of a major east-coast heavy precipitation event as early as 3-5 days prior.
- Heavy precipitation in this case appeared relatively predictable due to large-scale signal; great surge of moisture advected northwest between strong anticyclone over Atlantic and low pressure systems (Nicole + extratropical).
- Short-lead EnKF ensembles did a very good job with the maximum precipitation but had many members with axis too far west.
- Looking at SLP patterns, the ensemble members tended to develop one dominant storm, be it the northerly or southerly one, whereas in fact both kept their (weaker) identities.
- More to come as we dig into EnKF and its relative performance compared to operational models.

Probability and ensemble mean, GFS/EnKF

T254 GFS/EnKF 72-120 hour forecast from 2010092612

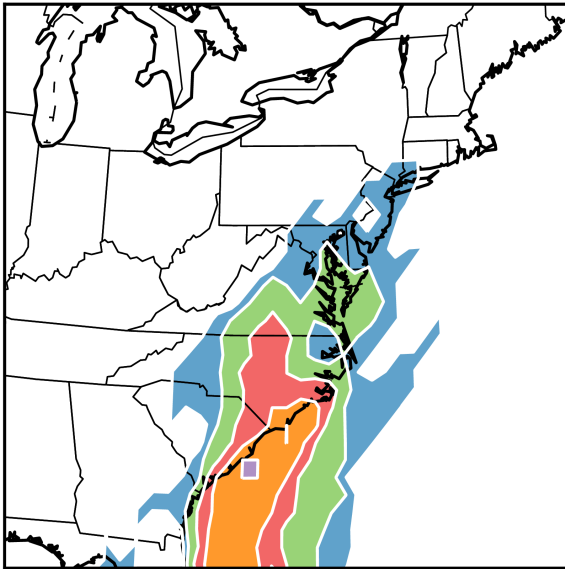


System appears to be a bit slow at this lead, with precip max too far south and west.
Ensemble mean is indicating widespread significant rain along I-95 corridor.

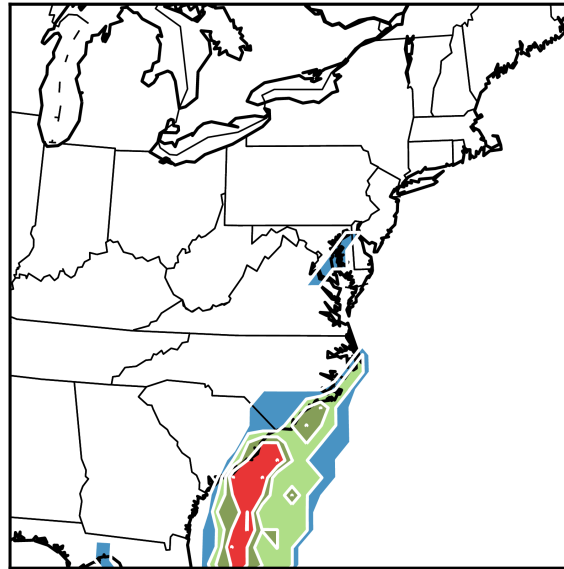
Probability and ensemble mean, GFS/EnKF

T254 GFS/EnKF 60-108 hour forecast from 2010092700

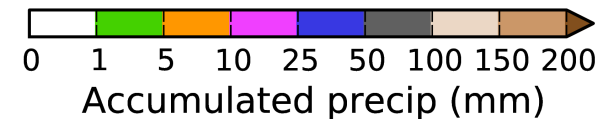
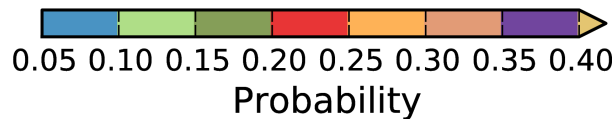
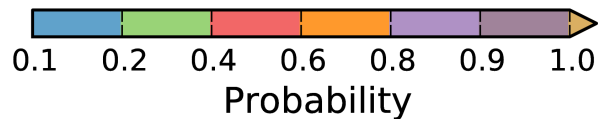
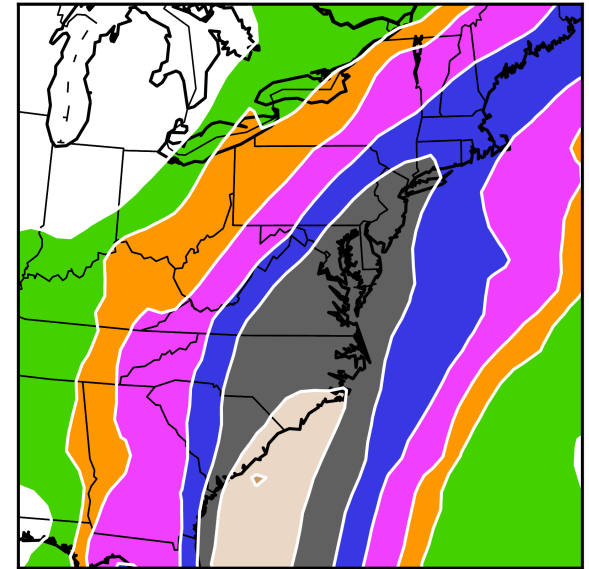
(a) P(48-h accum. precip > 100 mm)



(b) P(48-h accum. precip > 200 mm)



(c) 48-h accum ens-mean precip

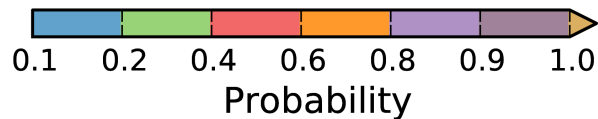
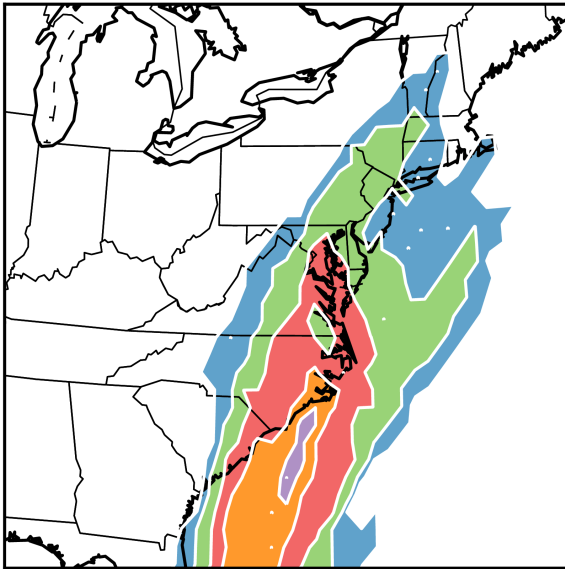


Still a bit slow.

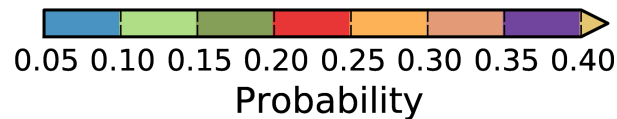
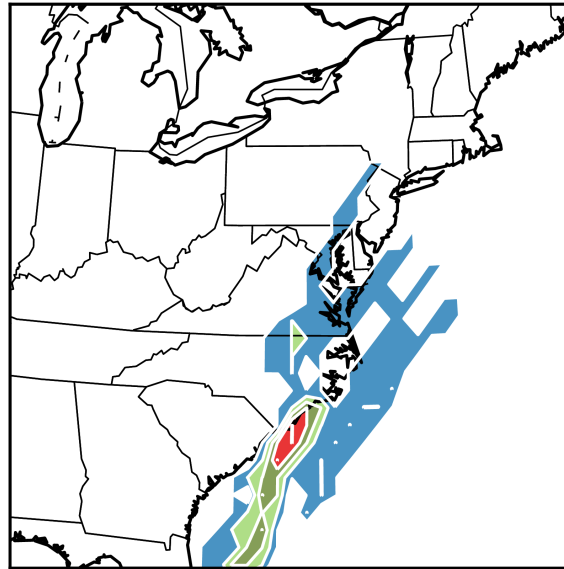
Probability and ensemble mean, GFS/EnKF

T254 GFS/EnKF 48-96 hour forecast from 2010092712

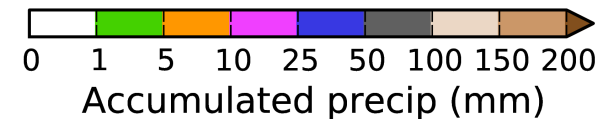
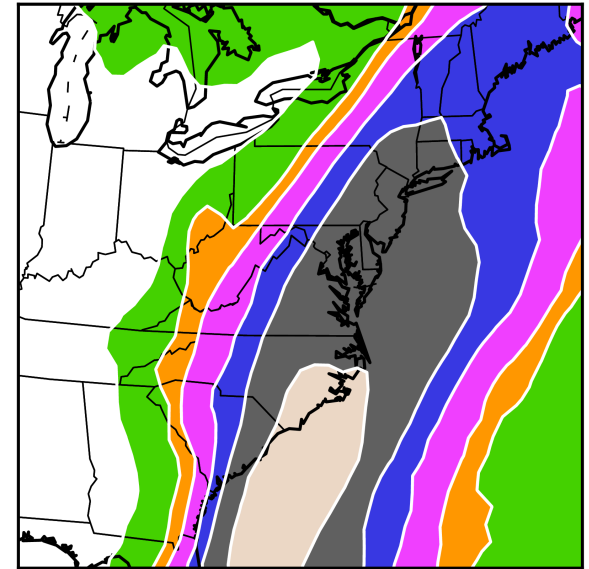
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(b) P(48-h accum. precip > 200 mm)



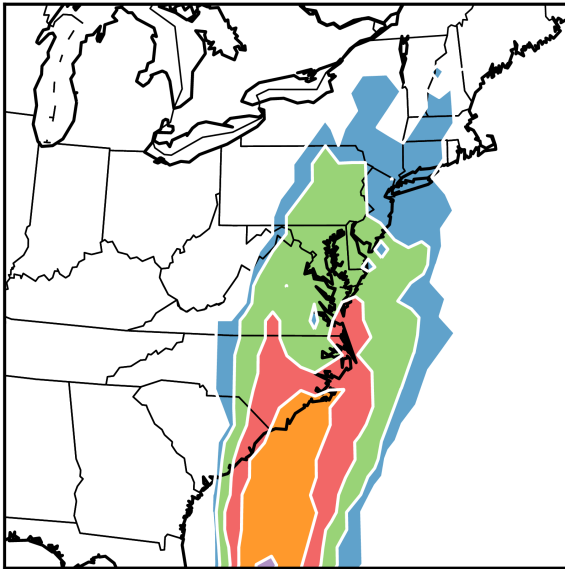
(c) 48-h accum ens-mean precip



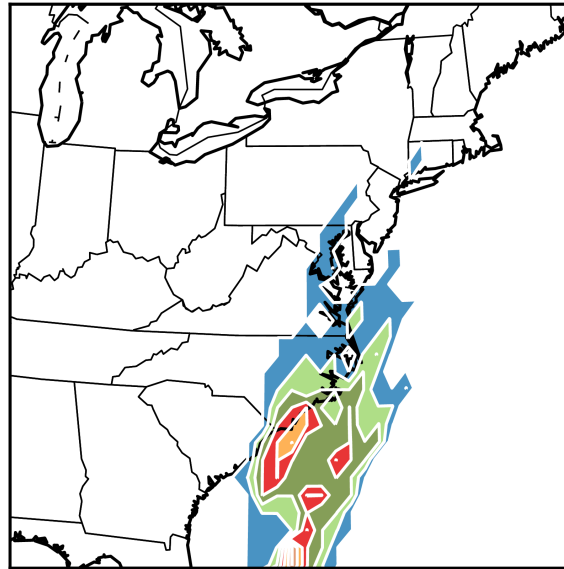
Probability and ensemble mean, GFS/EnKF

T254 GFS/EnKF 36-84 hour forecast from 2010092800

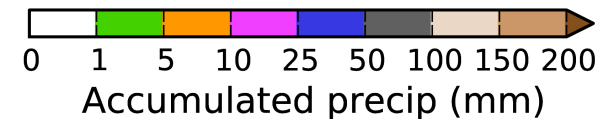
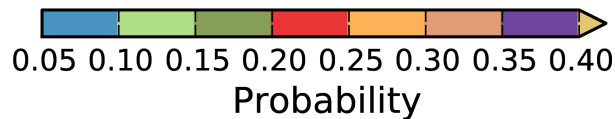
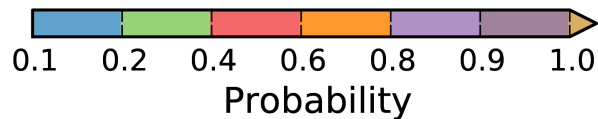
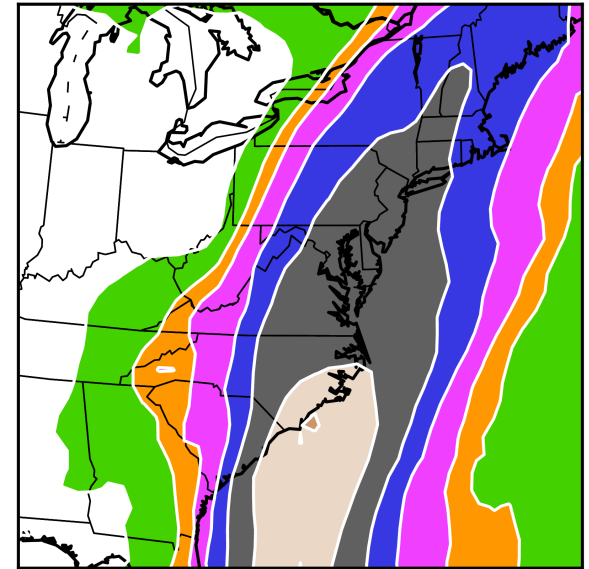
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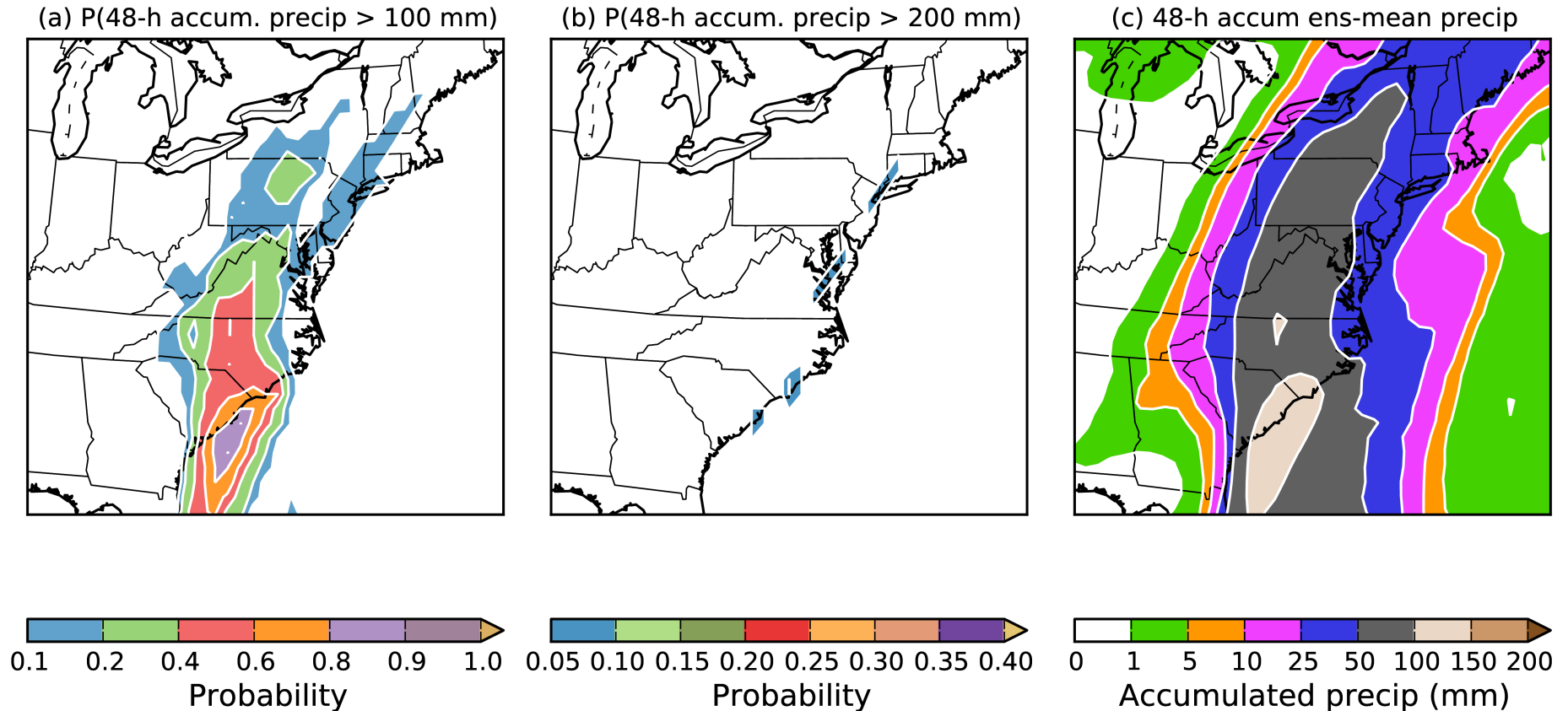


(c) 48-h accum ens-mean precip



Probability and ensemble mean, GFS/EnKF

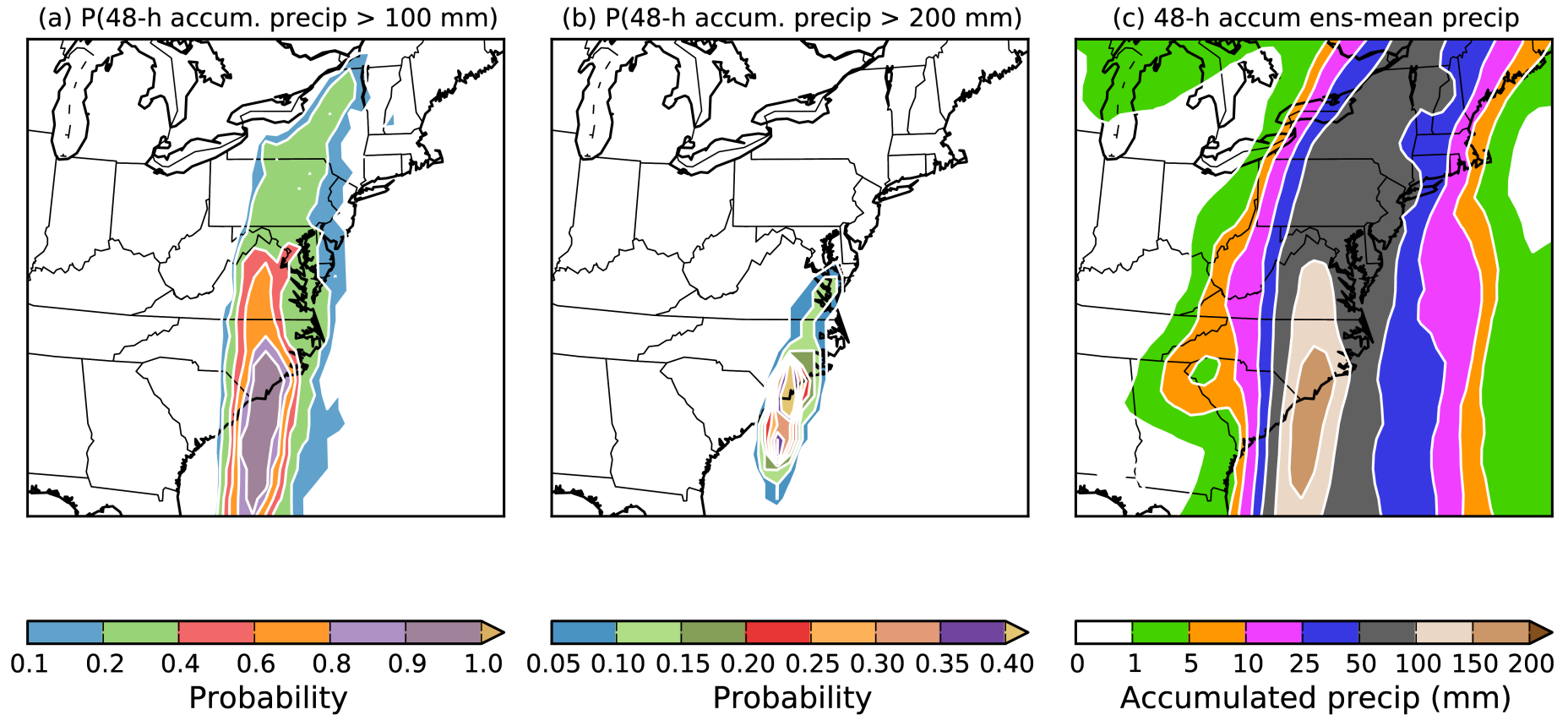
T254 GFS/EnKF 24-72 hour forecast from 2010092812



Axis of heavy precipitation jumps too far west, but still signal of major event.

Probability and ensemble mean, GFS/EnKF

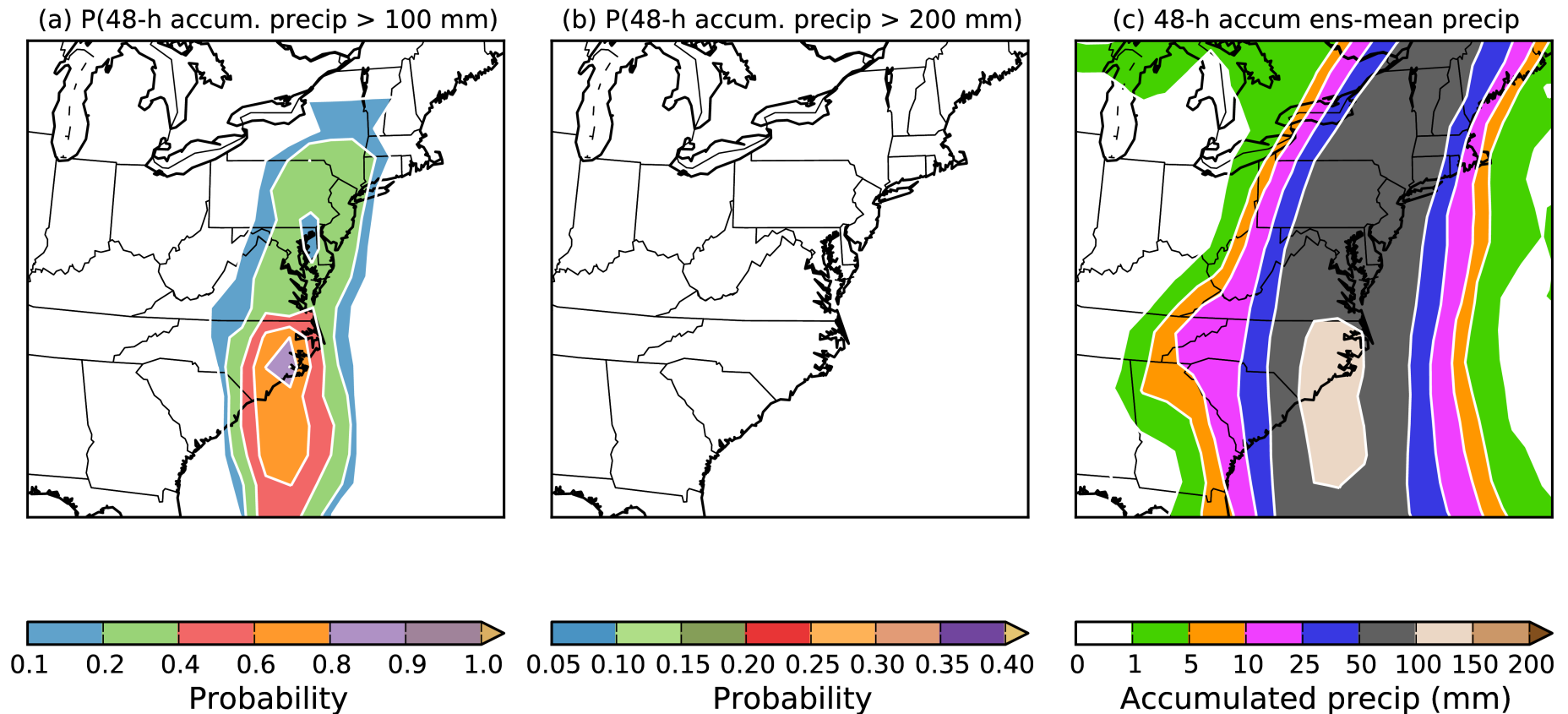
T254 GFS/EnKF 12-60 hour forecast from 2010092900



Axis of high probability for 100 mm too far west, but axis for 200 mm better. Ensemble-mean amounts in excess of 150 mm.

Probability and ensemble mean, NCEP

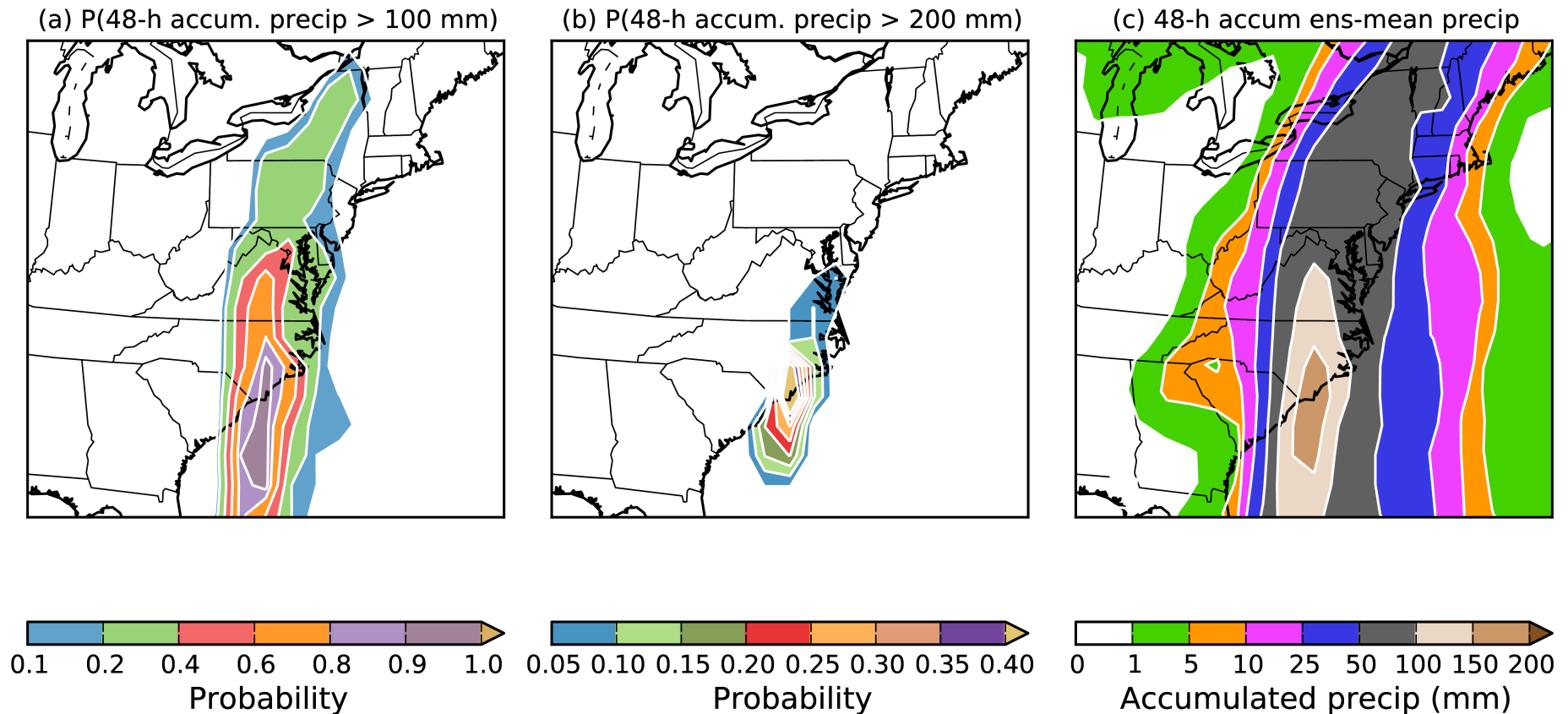
T190 Operational GFS, GSI-ETR 12-60 hour forecast from 2010092900



Better job with axis of high probability for 100 mm relative to GFS/EnKF on previous slide, but no probabilities in excess of 200 mm. Are the lesser amounts relative to GFS/EnKF a function of the coarser grid size (here, 1-degree grid vs. 0.5-degree for GFS-EnKF)?

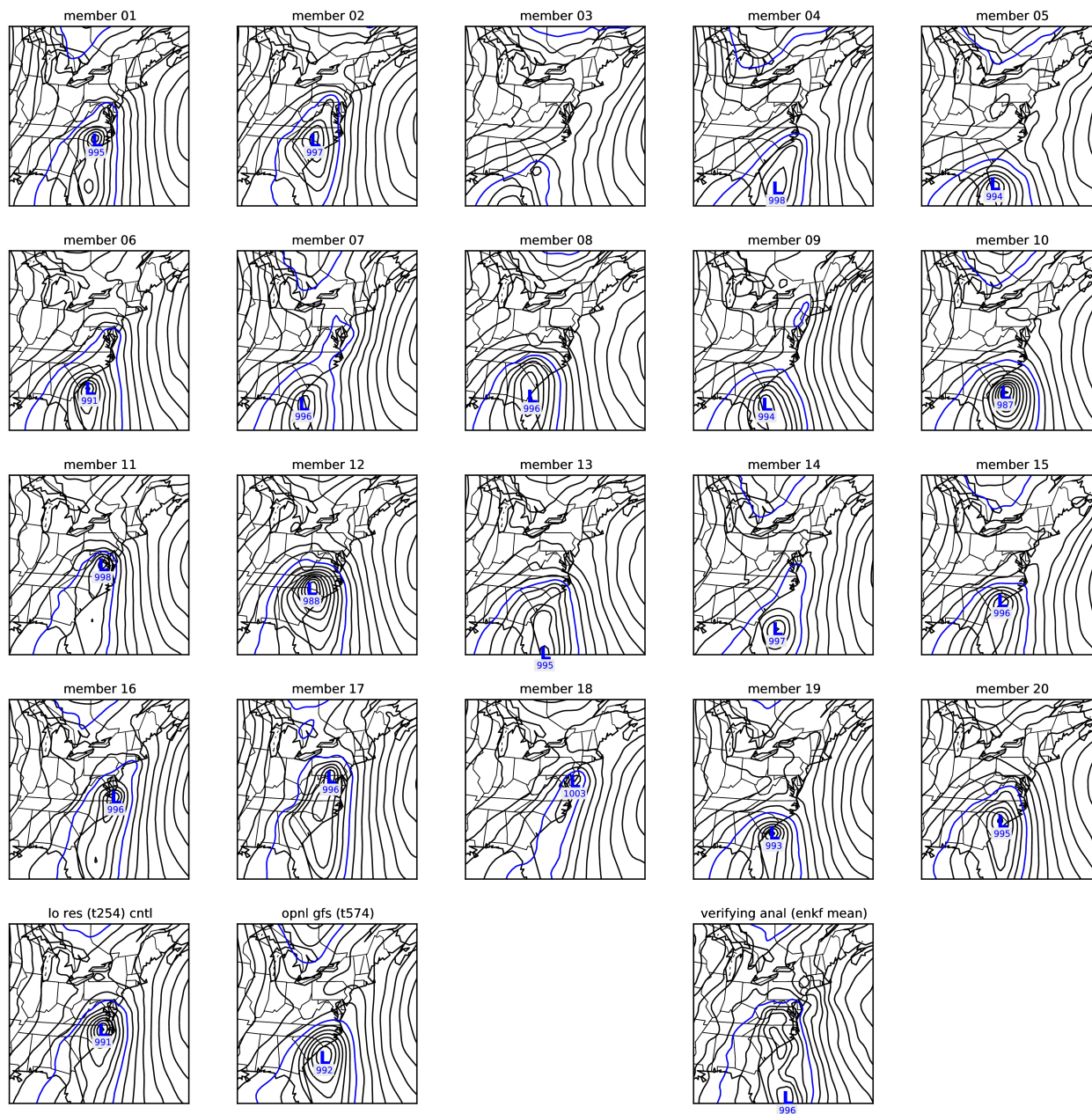
Probability and ensemble mean, GFS/EnKF, degraded to 1-degree grid of operational

T254 GFS/EnKF 12-60 hour forecast from 2010092900



Axis of high probability for 100 mm too far west, but axis for 200 mm better. Ensemble-mean amounts in excess of 150 mm.

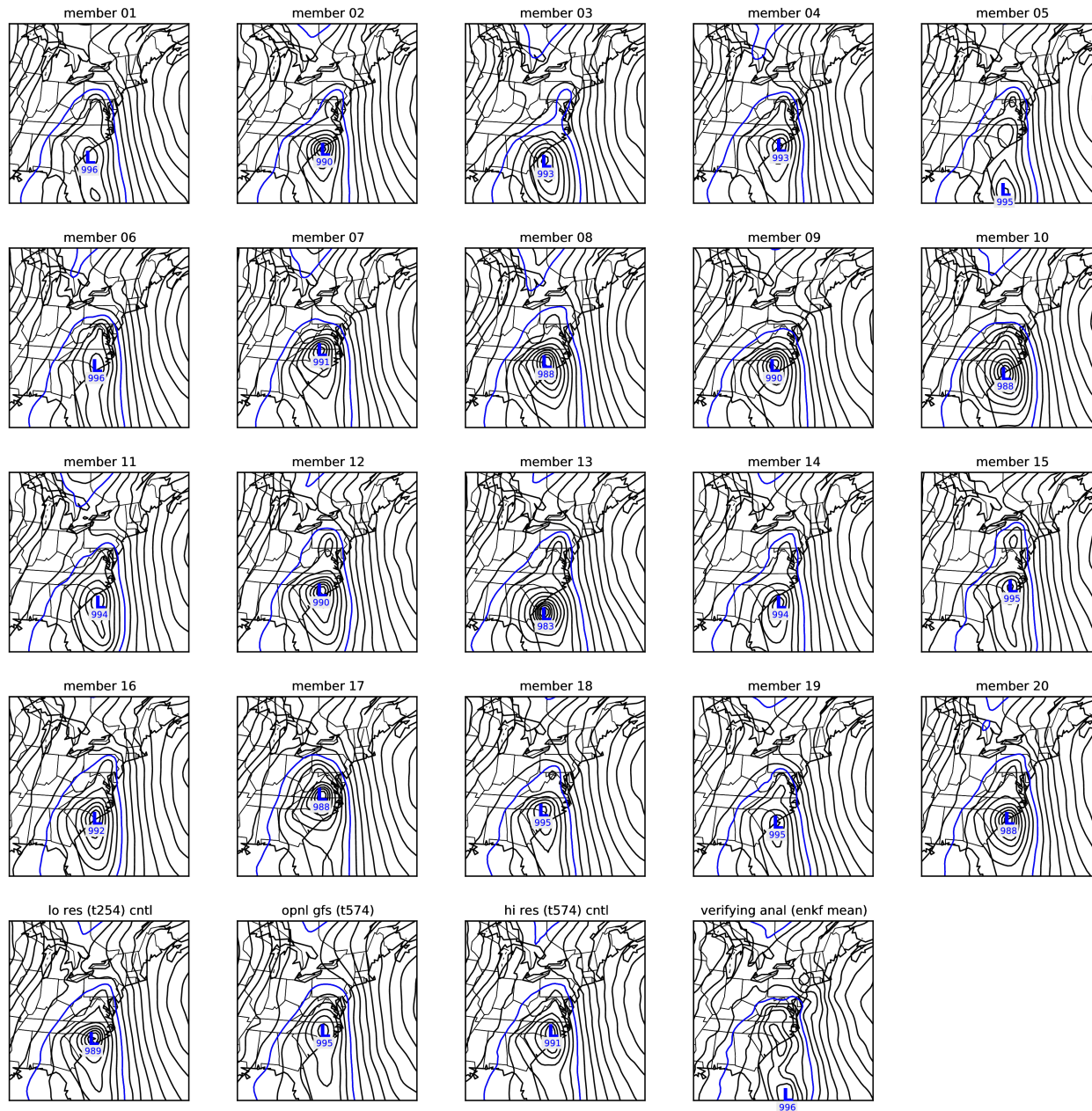
T254 GFS/EnKF MSLP ens 72-hr fcst for ATL from 2010092712



MSLP, 72-h
forecast from
12Z 27 Sep 2010

Note verifying analysis
in lower left does
not have the single
strong storm common
in many members

T254 GFS/EnKF MSLP ens 24-hr fcst for ATL from 2010092912



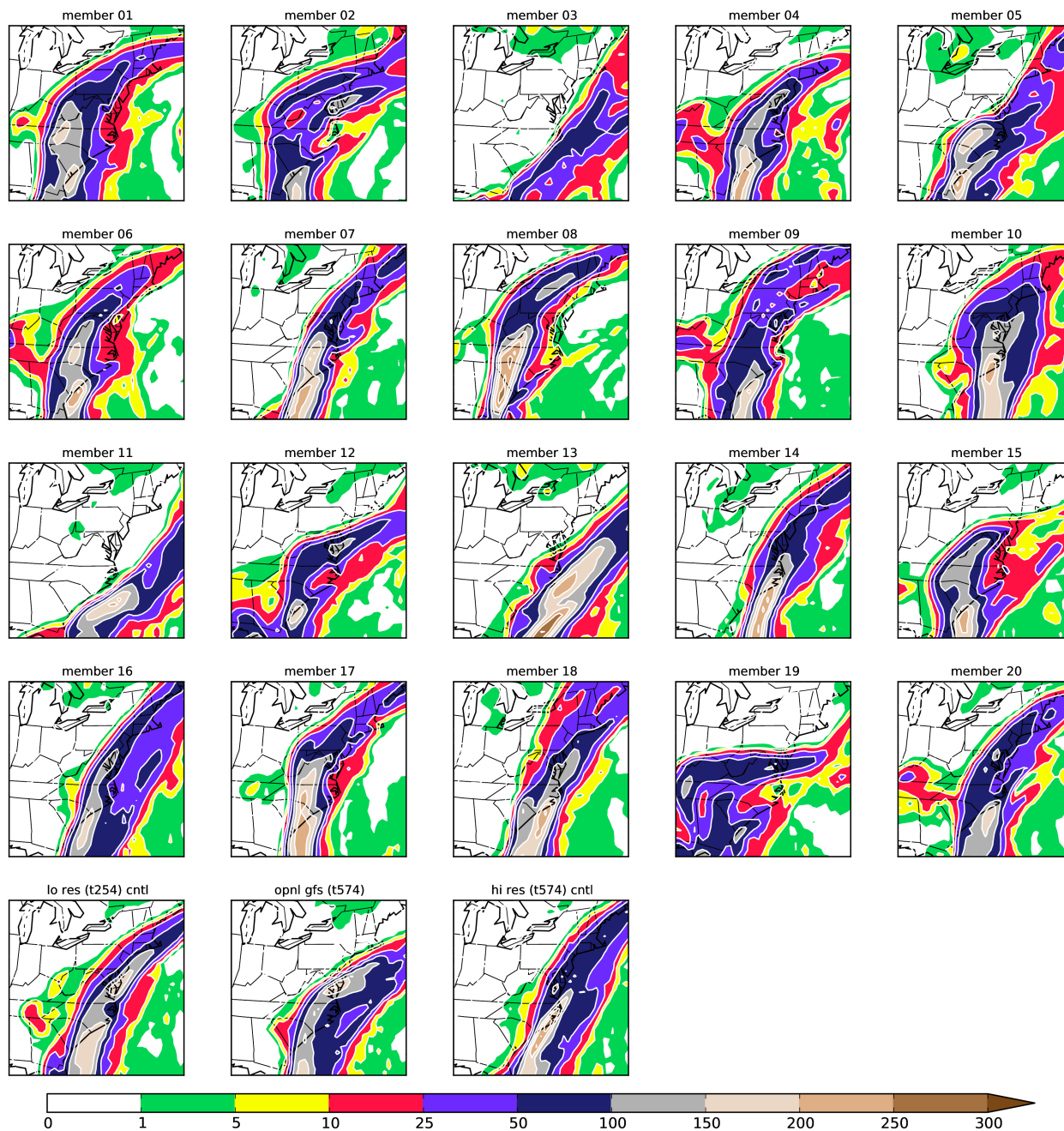
MSLP, 24-h
forecast from
12Z 29 Sep 2010

still tendency to
overforecast
remnants of
Nicole.

More to come...

- Objective verification statistics for this storm, and more generally for precipitation from EnKF forecasts over CONUS.
- Further EnKF development and testing, work with NCEP/EMC on hybrid.
- Your ideas?

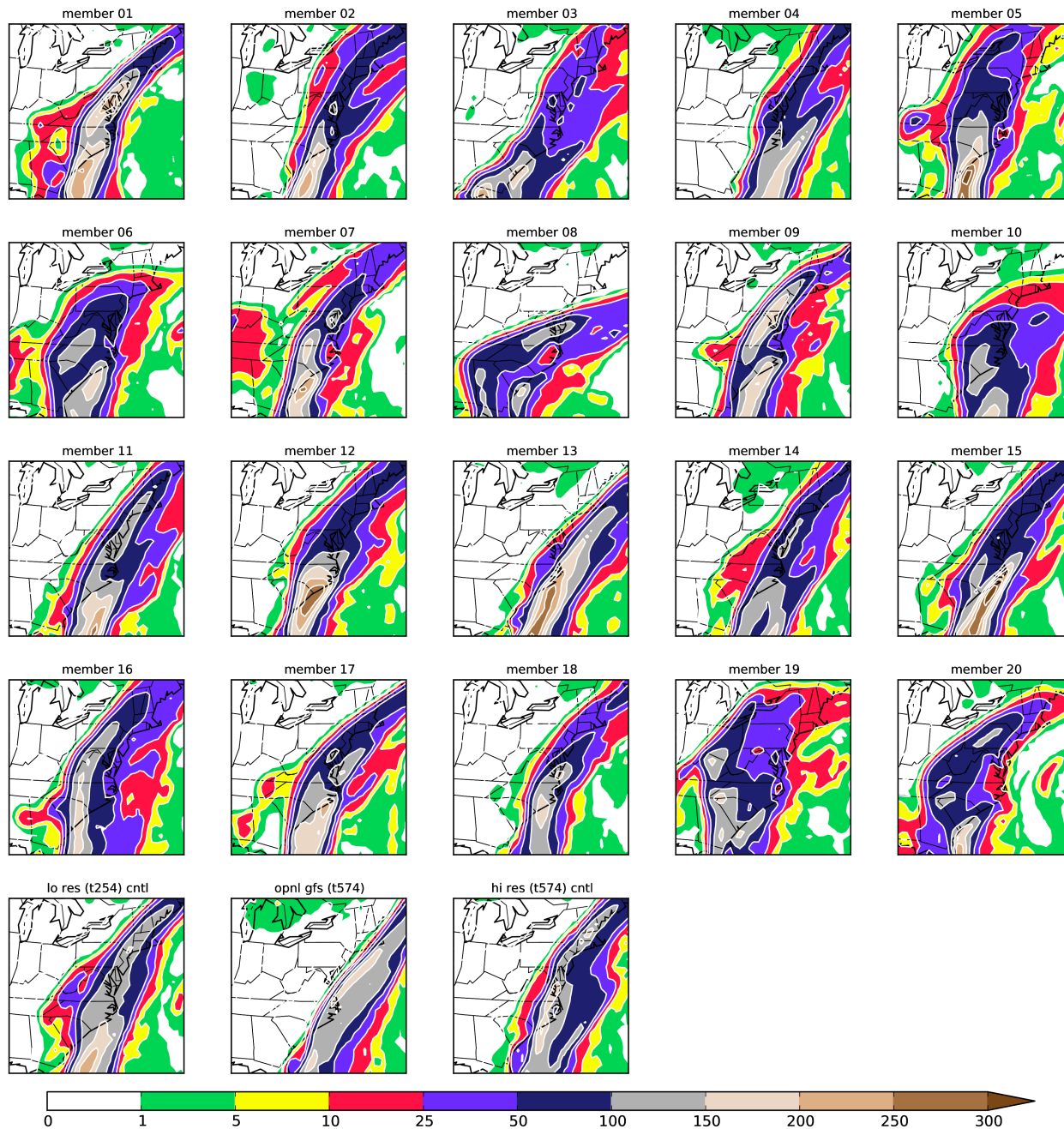
T254 GFS/EnKF Precip (mm) ens 72-120 hr fcst for ATL from 2010092612



Stamp maps,
48-h
accumulated
precipitation,
3-5 days
before storm

forecast storm totals are impressive; even with this T254 version of GFS (~70 km grid spacing), many members are forecasting 2-day accumulations in excess of 200 mm (8 inches). Operational GFS from GSI analysis also forecasting major event.

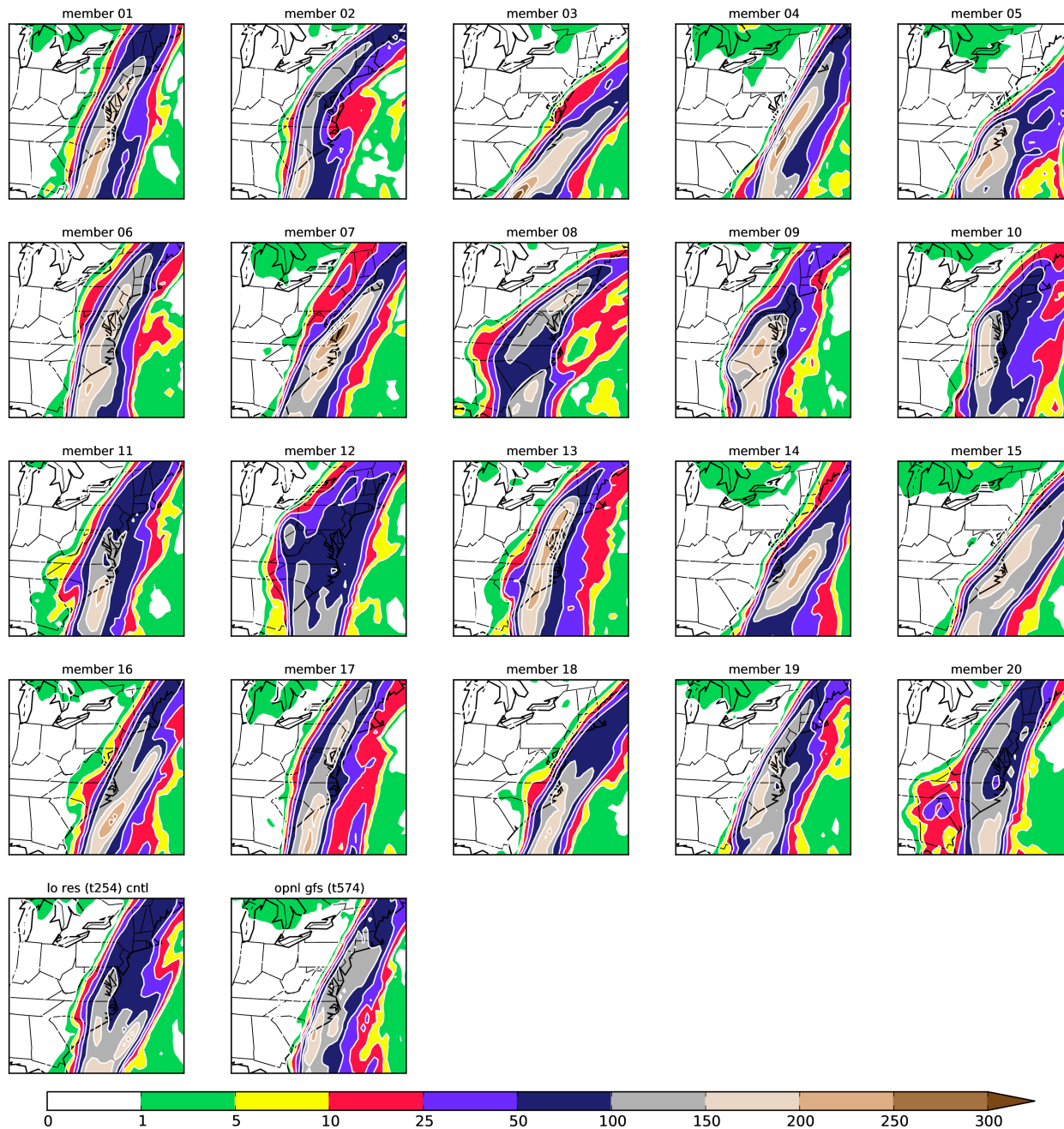
T254 GFS/EnKF Precip (mm) ens 60-108 hr fcst for ATL from 2010092700



Stamp maps,
48-h
accumulated
precipitation,
2.5-4.5 days
before storm

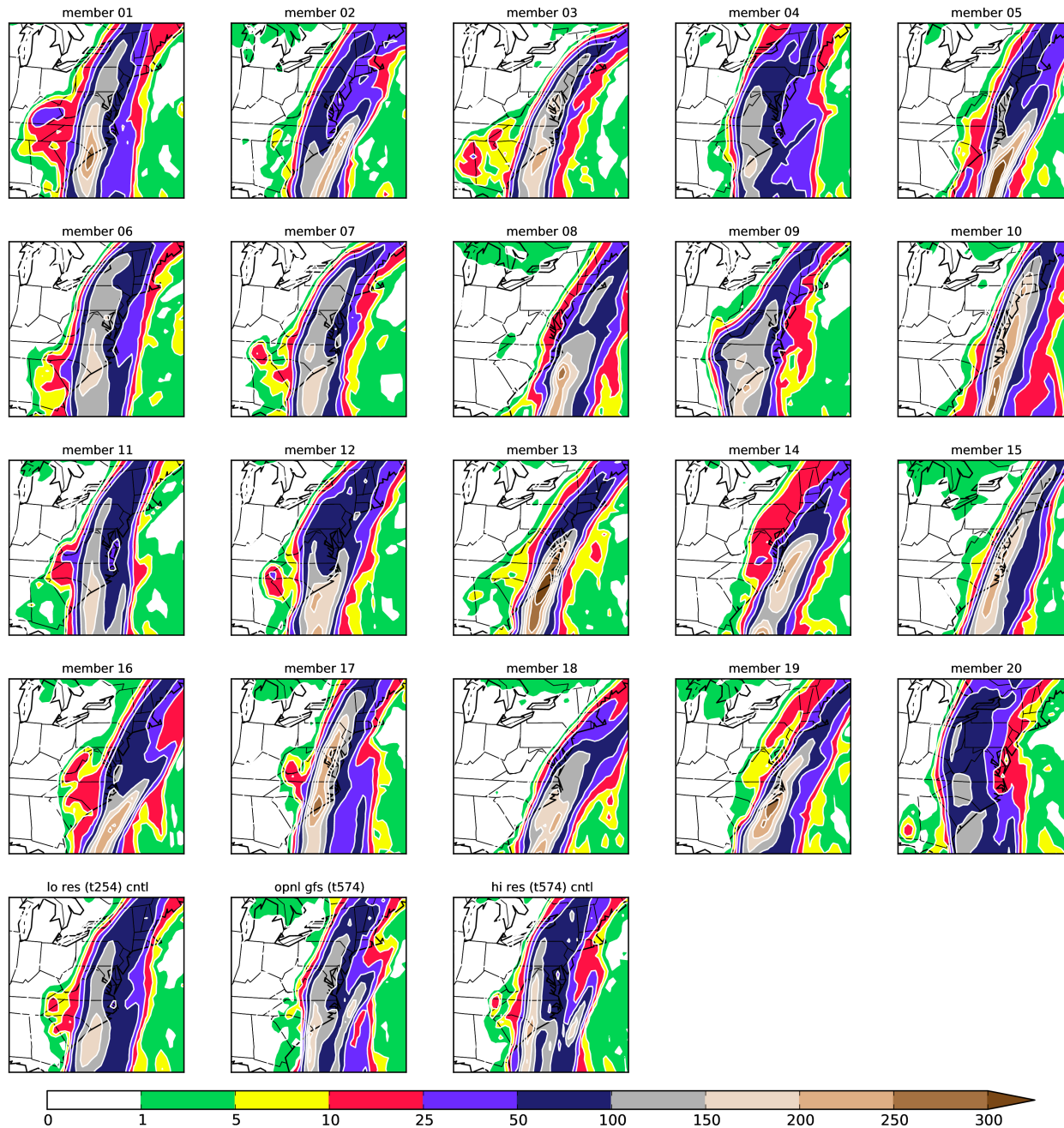
EnKF members
appear to be producing
more rain over land
than operational GFS.

T254 GFS/EnKF Precip (mm) ens 48-96 hr fcst for ATL from 2010092712



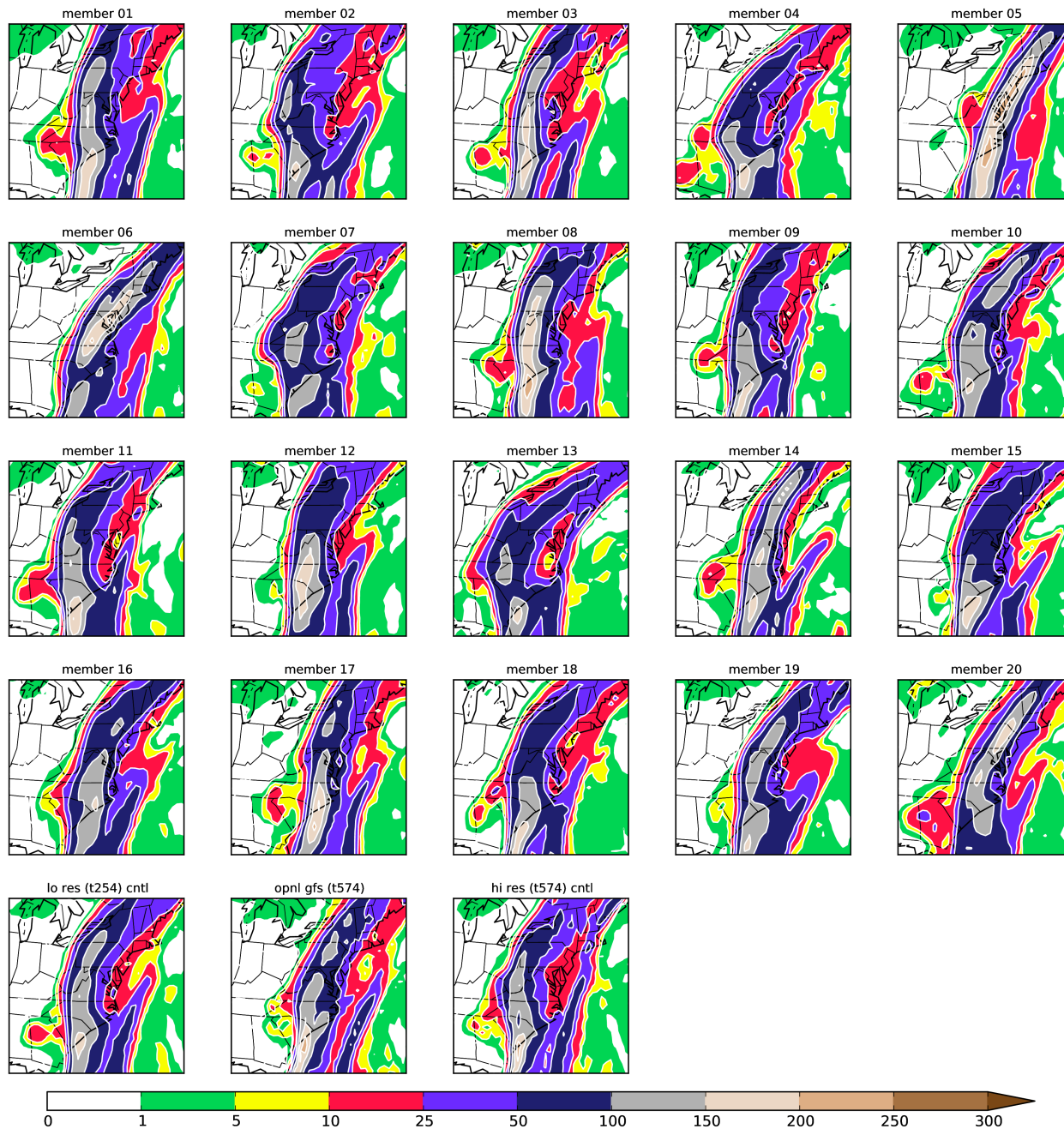
Stamp maps,
48-h
accumulated
precipitation,
2.0-4.0 days
before storm

T254 GFS/EnKF Precip (mm) ens 36-84 hr fcst for ATL from 2010092800



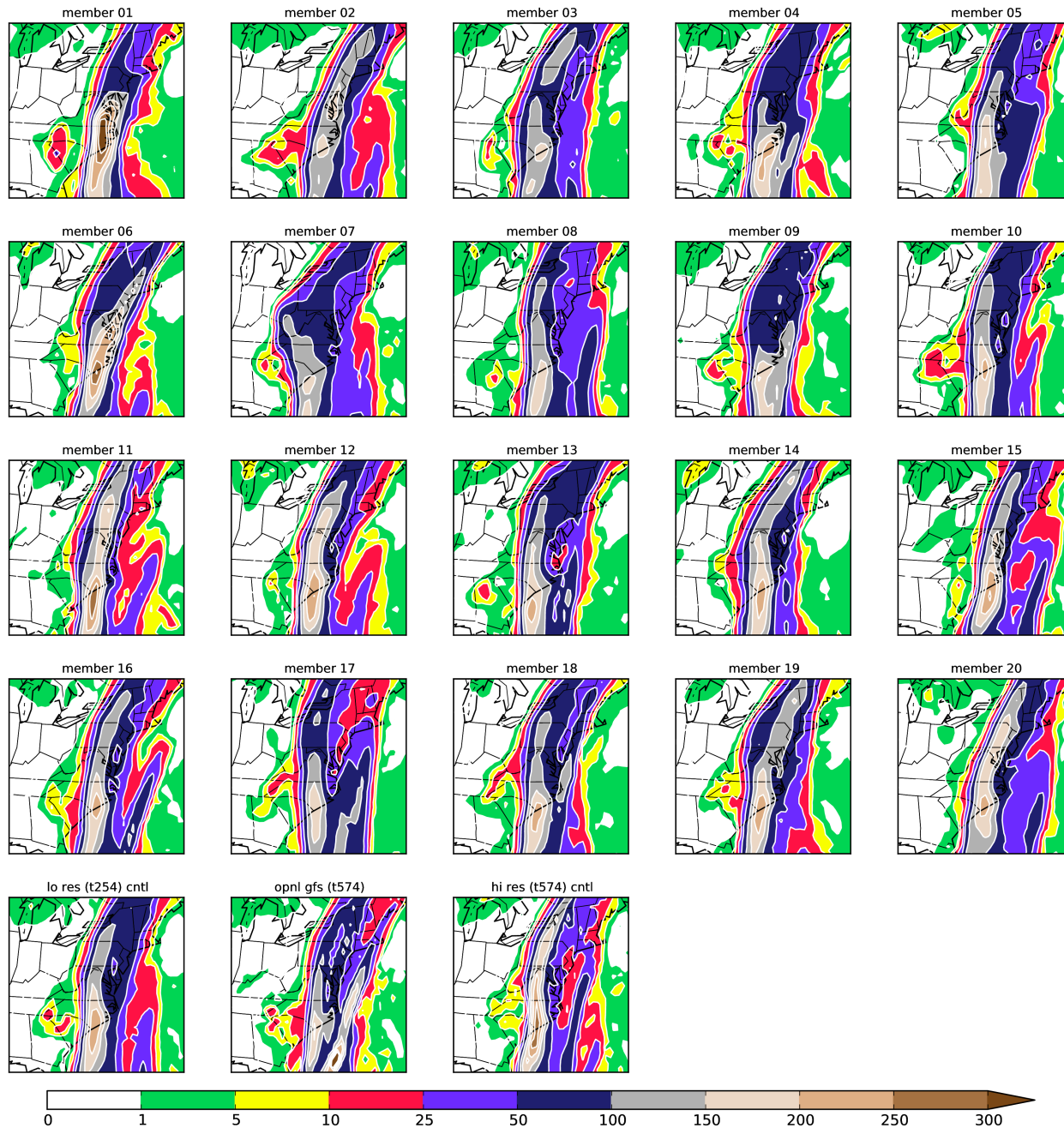
Stamp maps,
48-h
accumulated
precipitation,
1.5-3.5 days
before storm

T254 GFS/EnKF Precip (mm) ens 24-72 hr fcst for ATL from 2010092812



Stamp maps,
48-h
accumulated
precipitation,
1.0-3.0 days
before storm

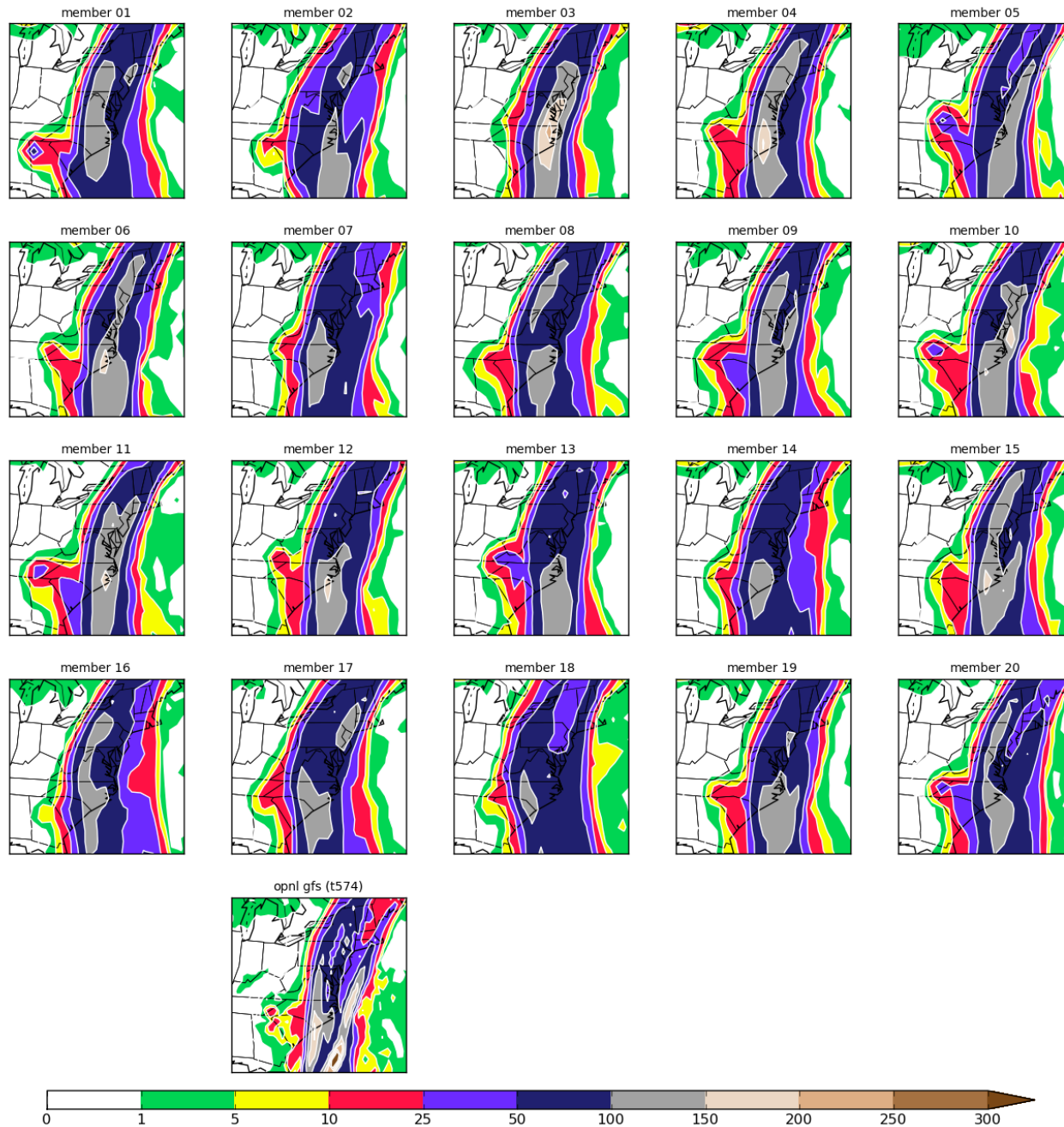
T254 GFS/EnKF Precip (mm) ens 12-60 hr fcst for ATL from 2010092900



Stamp maps,
48-h
accumulated
precipitation,
0.5-2.5 days
before storm.

member 1 predicts
in excess of 300 mm
(12 inches) in eastern
NC

T190 NCEP GSI-ETR Precip (mm) ens 12-60 hr fcst for ATL from 2010092900



NCEP
Operational
Stamp maps, 48-
h accumulated
precipitation,
0.5-2.5 days
before storm.

Comparing this to
previous slide, the
T254 GFS/EnKF
appears to have a
narrower swath
and heavier
precipitation.